TOOL STEEL CATALOGUE

BETHLEHEM STEEL COMPANY

BETHLEHEM, PENNSYLVANIA

TOOL STEEL
CATALOGUE

BETHLEHEM STEEL COMPANY

MAIN OFFICE AND WORKS:

BETHLEHEM, PENNSYLVANIA

SALES OFFICES

BOSTON, MASS.
Oliver Building

NEW YORK, N. Y.
Trinity Building

PHILADELPHIA, PA.
Morris Building

BALTIMORE, Md.
Continental Building

ATLANTA, GA.
Candler Building

PITTSBURGH, PA.
First National Bank Building

CLEVELAND, OHIO
Guardian Building

DETROIT, MICH.
Penobscot Building

CHICAGO, ILL.
Peoples' Gas Building

ST. LOUIS, MO.
Boatmen's Bank Building

SAN FRANCISCO, CAL.
Monadnock Building

WAREHOUSES

BOSTON, MASS.

CLEVELAND, OHIO

BETHLEHEM, PA.

THE announcement made at the Paris Exposition in 1900 of the discovery, at the works of the Bethlehem Steel Comapny, of a new alloy cutting steel and of the Taylor-White process for its treatment, revealed a new epoch to the mechanical world. It was found through demonstrations at this Exposition, and at this Company's works, that by the use of the Bethlehem Special High Speed Tool Steel, the earning power of a modern machine was increased over 100 per cent. This revolutionized machine shop practice. With the belief that there was still further room for development in this field, the Bethlehem Steel Company continued its investigations, and, after careful and extensive experiments, it is prepared to furnish a high speed steel from which metal-cutting tools can be made that show equally as radical an improvement over the tools produced in 1900 as that shown by the 1900 tool over those previously used.

The high speed and other tool steels which the Bethlehem Steel Company is now offering have no equal in cutting power and uniformity. This is a strong statement, but may be accepted with confidence. The Bethlehem Steel Company enjoys a world-wide reputation for the manufacture of the highest quality of all grades of steel and alloys.

READ CAREFULLY BEFORE ORDERING

PURPOSE

State in detail the purpose for which the steel will be used as this enables us to fill your orders correctly.

ANNEALING

Always specify whether annealed or unannealed steel is desired. To get under the "bark," order annealed Tool Steel large enough to remove at least one-sixteenth of an inch off the diameter of small sections and one-eighth of an inch off the diameter of large sections.

DISCS AND DIE BLOCKS

We will furnish the size ordered unless it is specified that an allowance for finish is desired.

WARRANTY

We will replace any steel which, if properly selected and used, shall prove defective, but no claims for labor or damage will be allowed.

Bethlehem Special High Speed Tool Steel

USES

A high speed steel for lathe, planer, boring, slotting, shaping and other roughing tools — also twist drills, milling cutters, taps, reamers, gear cutters, inserted saw teeth, inserted milling cutter teeth, special dies, etc.

REMARKS

This steel is especially adapted for taking the heaviest cuts at the highest speeds, at the same time retaining the full efficiency of its cutting edge.

At its forging heat this steel can be readily formed into shapes necessary for making intricate tools.

Its properties are such that it can be easily annealed.

We can insure to users of our High Speed Steel absolute uniformity in cutting qualities. This is accomplished by the testing of several tools made from bars forged from each heat of this steel on a specially prepared forging of High Carbon High Manganese steel, with a standard feed and depth of cut determined as representing the maximum efficiency of such tools.

State in detail the purpose for which the steel will be used

INSTRUCTIONS FOR WORKING

Bethlehem Special High Speed Tool Steel

PREPARING TOOL LENGTHS

In cutting tool lengths from bars of High Speed Steel, the bar should always be heated at the cutting point to a yellow color (about 1750 to 1850 degrees Fahrenheit). Never cut cold.

FORGING

Heat slowly and uniformly in a clean fire or furnace to 1750 to 1850 degrees Fahrenheit (a yellow color), allowing sufficient time to permit the heat to penetrate to the center of the piece. The tool should be reheated while being forged when the heat falls below 1750 degrees Fahrenheit.

To relieve forging strains, which may occur in irregularly shaped tools, it will be advisable, if not necessary, to reheat the tool, after forging, to a light cherry red, about 1550 degrees Fahrenheit, and bury in dry ashes or slacked lime until cold.

In either case, after forging, the tool should be allowed to cool before proceeding with the hardening operation.

HARDENING

(Lathe, planer, slotter and all types of forged roughing tools, that can be ground to shape after hardening).

Preheat the nose of the tool or its cutting portion slowly and uniformly to a temperature of about 1550 degrees Fahrenheit (a light cherry red) and then as rapidly as possible, up

to a white sweating heat. Then place the nose of the tool in a strong dry air blast until cold or quench in an oil bath which is large enough to rapidly radiate the heat. Any reliable quenching oil will be satisfactory.

Bethlehem Special High Speed tools can be successfully heated in a forge fire but more satisfactory and uniform results are obtained with a furnace designed for the purpose.

GRINDING

The high heats necessary to successfully harden high speed steel have a tendency to slightly deteriorate the outer portion of the metal of the tool. Consequently, it is advisable that the deteriorated metal should be ground off after hardening and before its use.

To remove the deteriorated metal grind at least one thirty-second (1-32") of an inch off the top and front of the nose of the tool.

Grinding should be done on a free cutting emery wheel, under a copious steady flow of water. An intermittent flow of water, allowing the tool to heat up and then again coming in contact with water will cause surface checks or cracks.

If the supply of water is irregular or not of sufficient quantity it will be better to grind the tool on a dry emery wheel, being careful not to heat the cutting edge of the tool.

HARDENING

(Formed milling cutters, taps, reamers, etc., and all types of finishing tools that cannot be ground to shape after hardening).

Preheat slowly and uniformly to a temperature of about 1550 degrees Fahrenheit (a light cherry red), and then as rapidly as possible, up to a light yellow color or until the surface of the tool appears glazed or oily, and quench in an

oil bath which is large enough to rapidly radiate the heat, and then draw the temper in oil heated to 450 degrees Fahrenheit.

These tools may also be hardened by cooling under an air blast if there is no objection to the slight formation of scale on the surface of the tool.

ANNEALING

To anneal this steel thoroughly, pack it with granulated charcoal in an iron box or pipe carefully sealed, with about one-half (½") an inch of charcoal between the steel to be annealed and the walls of the pipe or box, and heat slowly and uniformly until heat has penetrated to the center to a temperature of about 1500 to 1550 degrees Fahrenheit, (a light cherry red) and hold at this heat for several hours, allowing same to cool off slowly, preferably with the furnace, or the box or pipe may be removed from the furnace and buried in dry ashes or slacked lime. Under no circumstances, however, must the steel during the annealing process come in contact with the air.

Caution: In the annealing of tool steel, to make it dead soft, the outer surface of the bar is slightly decarbonized; this condition will hereinafter be referred to as "bark." In the manufacture of tools which cannot be ground to shape after hardening, it is necessary to remove all of the bark from the cutting edges to be able to successfully harden. To get under the bark remove at least one-sixteenths (1-16") of an inch off the diameter of small sections and at least one-eighth (⅛") of an inch off the diameter of large sections.

ROUND NOSE TURNING TOOLS

We are frequently requested to recommend a design of round nose tool for rough turning. On the opposite page are shown the cutting contour and angles of a 1" x 1½" round nose roughing tool which will remove the maximum amount of material with least wear and tear on the machine and tool.

While it is not absolutely necessary to adhere to this design, we strongly recommend that a standard of cutting contours and angles be adoped to suit the conditions in your shop.

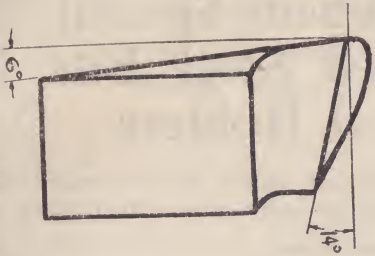
BETHLEHEM SPECIAL HIGH SPEED TOOL STEEL made into uniform tools, coupled with uniform heat treatment and careful grinding, means uniform maximum production.

Keep the tools sharp.

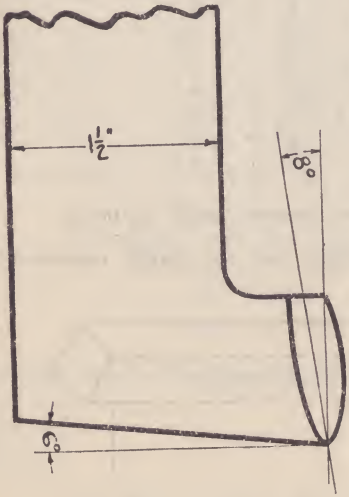
Do not run them to destruction before regrinding.

Do not blue or overheat the cutting edge in grinding.

Extras for size and annealing, page 15.



Side Rake of 14° is most generally used for medium hard steel but should be made 10° to 12° for harder material



Back Rake of 8° is constant for all material

Bethlehem Special High Speed Steel Bits for Tool Holders

Every bit is hardened singly by an expert who is familiar with the heat treatment of our High Speed Steel.

Packed in five pound boxes.

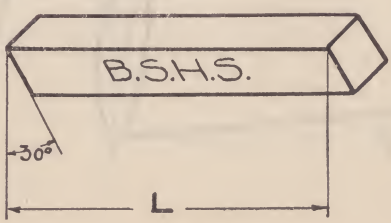
Grinding instructions are the same as those given on page 6 for Bethlehem Special High Speed Tool Steel.

The following sizes and lengths are carried in stock with ends cut to an angle of 30 degrees:

$\frac{3}{16}''$	sq.	x $2\frac{1}{2}''$
$\frac{1}{4}''$	"	x $2\frac{1}{2}''$
$\frac{5}{16}''$	"	x $2\frac{1}{2}''$
$\frac{3}{8}''$	"	x $3''$
$\frac{7}{16}''$	"	x $3\frac{1}{2}''$
$\frac{1}{2}''$	"	x $4''$
$\frac{9}{16}''$	"	x $4''$
$\frac{5}{8}''$	"	x $4\frac{1}{2}''$
$\frac{3}{4}''$	"	x $5''$
$\frac{7}{8}''$	"	x $6''$

Special sizes and lengths made to order.

Each bit is marked, and its length measured as illustrated below:



HIGH SPEED TOOL STEEL

STANDARD CLASSIFICATION OF EXTRAS

Rounds, Squares and Octagons

	Extra per lb.		Extra per lb.
$\frac{5}{8}$ to 2 in.	base	$4\frac{1}{8}$ to $4\frac{1}{2}$ in.	4c.
$\frac{1}{4}$ to $\frac{9}{32}$ in.	$8\frac{1}{2}$c.	$4\frac{5}{8}$ to 5 in.	$4\frac{1}{2}$c.
$\frac{5}{16}$ to $\frac{11}{32}$ in.	6c.	$5\frac{1}{8}$ to $5\frac{1}{2}$ in.	5c.
$\frac{7}{16}$ to $\frac{3}{8}$ in.	$3\frac{1}{2}$c.	$5\frac{5}{8}$ to 6 in.	$5\frac{1}{2}$c.
$\frac{9}{16}$ to $\frac{1}{2}$ in.	2c.	$6\frac{1}{8}$ to $6\frac{1}{2}$ in.	6c.
$2\frac{1}{8}$ to $2\frac{1}{2}$ in.	2c.	$6\frac{5}{8}$ to 7 in.	$6\frac{1}{2}$c.
$2\frac{5}{8}$ to 3 in.	$2\frac{1}{2}$c.	$7\frac{1}{8}$ to $7\frac{1}{2}$ in.	7c.
$3\frac{1}{8}$ to $3\frac{1}{2}$ in.	3c.	$7\frac{5}{8}$ to 8 in.	$7\frac{1}{2}$c.
$3\frac{5}{8}$ to 4 in.	$3\frac{1}{2}$c.	$8\frac{1}{8}$ to $8\frac{1}{2}$ in.	8c.

Flats

	Extra per lb.		Extra per lb.
$\frac{5}{8}$ to 2 x $\frac{5}{8}$ to 2 in.	base	$\frac{3}{8}$ x $\frac{7}{8}$ to $1\frac{1}{2}$ in.	3c.
$\frac{1}{8}$ x $\frac{1}{4}$ in.	30c.	$\frac{3}{8}$ x $1\frac{5}{8}$ to 5 in.	$2\frac{1}{2}$c.
$\frac{1}{8}$ x $\frac{5}{16}$ in.	20c.	$\frac{7}{16}$ x $\frac{1}{2}$ to 1 in.	3c.
$\frac{1}{8}$ x $\frac{3}{8}$ to 2 in.	14c.	$\frac{7}{16}$ x $1\frac{1}{8}$ to $5\frac{1}{2}$ in.	$2\frac{1}{2}$c.
$\frac{3}{16}$ x $\frac{1}{4}$ to 3 in.	14c.	$\frac{1}{2}$ x $\frac{5}{8}$ to 1 in.	$2\frac{1}{2}$c.
$\frac{1}{4}$ x $\frac{5}{16}$ to $\frac{1}{2}$ in.	8c.	$\frac{1}{2}$ x $1\frac{1}{8}$ to 6 in.	2c.
$\frac{1}{4}$ x $\frac{5}{8}$ to 1 in.	5c.	$\frac{9}{16}$ x $\frac{5}{8}$ to 1 in.	$2\frac{1}{2}$c.
$\frac{1}{4}$ x $1\frac{1}{8}$ to 4 in.	3c.	$\frac{9}{16}$ x $1\frac{1}{8}$ to 6 in.	2c.
$\frac{5}{16}$ x $\frac{3}{8}$ to $\frac{5}{8}$ in.	5c.	$\frac{5}{8}$ to 2 x $2\frac{1}{8}$ to 4 in.	2c.
$\frac{5}{16}$ x $\frac{3}{4}$ to 1 in.	$3\frac{1}{2}$c.	$\frac{5}{8}$ to 2 x $4\frac{1}{8}$ to 7 in.	4c.
$\frac{5}{16}$ x $1\frac{1}{8}$ to $4\frac{1}{2}$ in.	3c.	$2\frac{1}{8}$ to 3 x $2\frac{1}{8}$ to 4 in.	2c.
$\frac{3}{8}$ x $\frac{7}{16}$ to $\frac{3}{4}$ in.	3c.	$2\frac{1}{8}$ to 3 x $4\frac{1}{8}$ to 7 in.	4c.

Intermediate sizes take next higher extra.

All dimensions inclusive.

Annealing 2 cents per pound extra.

Bevels, same classification as flats plus 10¢ per lb. for shape.

Boxing — at cost.

Cutting to specified single and multiple lengths.

24 in. and over	1 cent per lb. extra
18 to $23\frac{15}{16}$ in	2 cents per lb. extra
12 to $17\frac{15}{16}$ in	3 cents per lb. extra
6 to $11\frac{15}{16}$ in	4 cents per lb. extra

Less than 6 inches special price.

(Continued)

HIGH SPEED TOOL STEEL

STANDARD CLASSIFICATION OF EXTRAS

Discs

	Extra per lb.
Weighing above 25 pounds	6 cents
Weighing 15 to 25 pounds	10 cents
Weighing 10 to 15 pounds	12 cents
Weighing 7½ to 10 pounds	14 cents
Weighing 5 to 7½ pounds	16 cents
Weighing 3 to 5 pounds	18 cents
Weighing 2 to 3 pounds	22 cents
Weighing 1 to 2 pounds	24 cents
Annealing	2 cents

Die Blocks

	Extra per lb.
Weighing above 25 pounds	4 cents
Weighing 15 to 25 pounds	6 cents
Weighing 10 to 15 pounds	10 cents
Weighing 7½ to 10 pounds	14 cents
Weighing 5 to 7½ pounds	16 cents
Weighing 3 to 5 pounds	18 cents
Weighing 2 to 3 pounds	22 cents
Weighing 1 to 2 pounds	24 cents
Annealing	2 cents

DISCS and DIE BLOCKS will be furnished to the size ordered unless it is specified that an allowance for finish is desired.

State in detail the purpose for which the steel will be used

CARBON TOOL STEELS

STANDARD CLASSIFICATION OF EXTRAS

Round, Square, Octagon and Hexagon

$\frac{5}{8}$ to 2 inches.....Base

Inches	Extra per lb. Cents
$2\frac{1}{8}$ to 3	1.0
$3\frac{1}{8}$ to 4	1.5
$4\frac{1}{8}$ to 5	2.0
$5\frac{1}{8}$ to 6	2.5
$6\frac{1}{8}$ to 7	3.0
$7\frac{1}{8}$ to 8	3.5
$8\frac{1}{8}$ to 9	4.0
$9\frac{1}{8}$ to 10	5.0

Inches	Extra per lb. Cents
$\frac{9}{16}$ to $\frac{1}{2}$	0.5
$\frac{7}{16}$ to $\frac{3}{8}$	1.0
$\frac{5}{16}$ and $\frac{11}{32}$	2.0
$\frac{1}{4}$ and $\frac{9}{32}$	3.0
$\frac{3}{16}$	5.0
$\frac{5}{32}$	10.0
$\frac{1}{8}$	18.0

Flat

$\frac{5}{8}$ to 2 inches thick x $\frac{9}{16}$ to 2 inches wide.....Base

Inches	Extra per lb. Cents
$\frac{1}{8}$ x $\frac{3}{16}$	20.0
$\frac{1}{8}$ x $\frac{1}{4}$	15.0
$\frac{1}{8}$ x $\frac{5}{16}$	8.0
$\frac{1}{8}$ x $\frac{3}{8}$	4.0
$\frac{1}{8}$ x $\frac{7}{16}$ to $\frac{1}{2}$	3.0
$\frac{1}{8}$ x $\frac{9}{16}$ to 7	2.0
$\frac{1}{8}$ x $7\frac{1}{8}$ to 8	3.0
$\frac{3}{16}$ x $\frac{1}{4}$	5.0
$\frac{3}{16}$ x $\frac{5}{16}$	4.0
$\frac{3}{16}$ x $\frac{3}{8}$	3.0
$\frac{3}{16}$ x $\frac{7}{16}$ to $\frac{5}{8}$	2.0
$\frac{3}{16}$ x $\frac{11}{16}$ to 2	1.5
$\frac{3}{16}$ x $2\frac{1}{8}$ to 7	1.0
$\frac{3}{16}$ x $7\frac{1}{8}$ to 8	2.0
$\frac{1}{4}$ x $\frac{5}{16}$ to $\frac{3}{8}$	2.0
$\frac{1}{4}$ x $\frac{7}{16}$ to $\frac{5}{8}$	1.5
$\frac{1}{4}$ x $\frac{11}{16}$ to 2	1.5
$\frac{1}{4}$ x $2\frac{1}{8}$ to 7	1.0
$\frac{1}{4}$ x $7\frac{1}{8}$ to 8	2.0

Inches	Extra per lb. Cents
$\frac{5}{16}$ x $\frac{3}{8}$ to $\frac{5}{8}$	1.5
$\frac{5}{16}$ x $\frac{11}{16}$ to 8	1.0
$\frac{3}{8}$ x $\frac{7}{16}$ to 8	1.0
$\frac{7}{16}$ x $\frac{1}{2}$ to 8	1.0
$\frac{1}{2}$ x $\frac{9}{15}$ to 8	1.0
$\frac{9}{16}$ x $2\frac{1}{8}$ to 8	1.0
$\frac{5}{8}$ to 2 x $2\frac{1}{8}$ to 7	1.0
$\frac{5}{8}$ to $1\frac{3}{4}$ x $7\frac{1}{8}$ to 8	1.0
$1\frac{7}{8}$ to 2 x $7\frac{1}{8}$ to 8	1.5
$2\frac{1}{8}$ to 3 x $2\frac{1}{8}$ to 5	1.0
$2\frac{1}{8}$ to 3 x $5\frac{1}{8}$ to 8	1.5
$3\frac{1}{8}$ to 4 x $3\frac{1}{8}$ to 6	1.5
$3\frac{1}{8}$ to 4 x $6\frac{1}{8}$ to 8	2.0
$4\frac{1}{8}$ to 5 x $4\frac{1}{8}$ to 7	2.0
$4\frac{1}{8}$ to 5 x $7\frac{1}{8}$ to 8	2.5
$5\frac{1}{8}$ to 6 x $5\frac{1}{8}$ to 8	2.5
$6\frac{1}{8}$ to 7 x $6\frac{1}{8}$ to 7	3.0
$6\frac{1}{8}$ to 8 x $7\frac{1}{8}$ to 8	3.5

Intermediate sizes take the next higher extra.

Annealed Steel.....1 cent per lb. extra

Boxing—at cost.

Cutting to Specified Single and Multiple Lengths

	Per lb. cents
24 inches or over	0.5
18 to 24 inches	1.0
12 to 18 inches	1.5
6 to 12 inches	2.0

Less than 6 inches, special price. Over 18 feet, special price.

(CONTINUED)

Carbon Tool Steels Standard Classification of Extras

DISCS

Under 1 lb.	15¢ per lb. extra
1 to 2 lbs.	12¢ per lb. extra
2 to 3 lbs.	11¢ per lb. extra
3 to 4 lbs.	10¢ per lb. extra
4 to 5 lbs.	9¢ per lb. extra
5 to 7½ lbs.	8¢ per lb. extra
7½ to 10 lbs.	7¢ per lb. extra
10 to 15 lbs.	6¢ per lb. extra
15 to 20 lbs.	5¢ per lb. extra
20 to 25 lbs.	4¢ per lb. extra
Above 25 lbs.	3¢ per lb. extra
Annealing	1¢ per lb. extra

DIE BLOCKS

Under 1 lb.	Special Price
1 to 2 lbs.	12¢ per lb. extra
2 to 3 lbs.	11¢ per lb. extra
3 to 5 lbs.	9¢ per lb. extra
5 to 7½ lbs.	8¢ per lb. extra
7½ to 10 lbs.	7¢ per lb. extra
10 to 15 lbs.	5¢ per lb. extra
15 to 25 lbs.	3¢ per lb. extra
Above 25 lbs.	2¢ per lb. extra
Annealing	1¢ per lb. extra

DISCS and DIE BLOCKS will be furnished to the size ordered unless it is specified that an allowance for finish is desired.

State in detail the purpose for which the steel will be used

GENERAL INSTRUCTIONS FOR WORKING
Bethlehem Tool Steels

It is well known to those skilled in the art that it is a very difficult matter to lay down a hard and fast rule for the successful hardening of Tool Steel as much depends on the shape and size or mass of steel to be hardened, the Carbon content or temper number, in the case of Carbon Tool Steels, and the composition of the special or alloy Tool Steel. However, we are always ready and willing to advise and give our customers the benefit of our vast and diversified experience in the use and heat treatment of all our steels, provided they will describe in detail the kind or grade of steel, the purpose for which it is to be used, or if the tool cannot be described, a drawing or rough sketch, with approximate dimensions will assist us materially in recommending the grade of steel, and the heat treatment to obtain the best results.

FORGING

Heat slowly and uniformly in a clean fire or furnace to a temperature of 1500 to 1600 degrees Fahrenheit, (a light cherry red) allowing sufficient time to permit the forging heat to penetrate to the center of the piece, bearing in mind that while it is necessary to heat slowly it is very much more important that it be heated to the forging heat throughout, being careful not to hold the steel in the fire or furnace any longer than necessary. Too long an exposure at the forging heat will cause excessive scaling and decarbonization

of the outer surface. After forging, all intricate or irregular shaped tools, such as goose neck planer tools, spring tools, etc., should be again reheated to the annealing temperature, 1400 to 1425 degrees Fahrenheit, and buried in dry ashes or slacked lime until cold to remove forging stresses.

GRINDING

Lathe and Planer Finishing Tools and the like, before hardening should be rough ground to the shape desired to eliminate excessive grinding after hardening and thereby avoid the danger of checking or over-heating the cutting edge during this operation.

ANNEALING

To anneal Tool Steel, thoroughly pack it with granulated charcoal in an iron box or pipe, carefully sealed with about one-half (½") an inch of charcoal between the steel to be annealed and the walls of the pipe or box and heat slowly and uniformly to a temperature of about 1400 to 1425 degrees Fahrenheit, allowing sufficient time to permit the heat to penetrate to the center. Cool off slowly, preferably with the furnace, or the box or pipe may be removed from the furnace and buried in dry ashes or slacked lime until cold.

We do not want to create the impression that our tool steels require exceptionally careful handling to obtain results. The above suggestions are intended for the guidance of those who are learning the art of tool making and hardening. The experienced mechanic who knows and practices the fundamental principles will have no difficulty in obtaining good results.

Rock and Mining Drill Steel

Octagons, Hexagons, Quarter Octagons

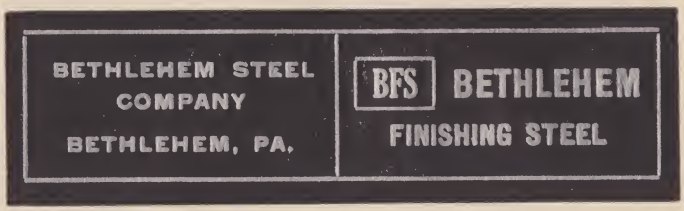
We are prepared to furnish Drill Steel in the following well known grades:

Bethlehem XX Drill Steel
Bethlehem XCL Drill Steel
Bethlehem X Drill Steel

For General Instructions see page 19.

Extras for size and annealing, page 17.

Bethlehem BFS Finishing Steel



USES

A very superior alloy water hardening tool steel which we strongly recommend for the following purposes:

Chilled roll and brass turning tools, master tools and taps, milling cutters, reamers, cutters for finish reaming, boring and rifling guns, automatic screw machine forming tools, threading tools, chasers and dies, burnishing dies, cold drawing dies and mandrels for cold drawing High Speed and Carbon tools steels, brass, bronze, copper and steel tubing and bars.

TREATMENT

The hardening temperatures range between 1400 to 1475 degrees Fahrenheit, depending on the shape and size of the tool to be hardened.

Quench in water.

Temper finishing tools to a light straw color.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem XXX Special Tool Steel

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.	BETHLEHEM XXX SPECIAL TOOL STEEL

USES

The very best grade of Carbon finishing tool steel, and may be used for all purposes for which **BETHLEHEM FINISHING STEEL** is recommended and will give equally good results, if the cutting speeds are reduced to meet conditions. When machining the softer metals at the same cutting speeds, the only noticeable difference between the two steels is the fact that **BETHLEHEM FINISHING STEEL** will hold a keen, sharp cutting edge for a longer period, and consequently will require less grinding.

TREATMENT

The hardening temperatures range between 1400 to 1475 degrees Fahrenheit, depending on the shape and size of the tool to be hardened.

Quench in water.

Temper to suit conditions.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem XX Tool Steel

USES

A general purpose tool steel, carried in stock in all tempers, suitable for the following purposes:

Taps and reamers, milling cutters, punches, stamping and blanking dies, broaches, blacksmith tools, boilermakers' tools, granite and mining drills and tools, wood-working tools, shear blades, chisels, rivet sets, drop forging dies, cold heading bolt and rivet dies, headers, triming dies, and cold drawing dies.

TREATMENT

Hardening temperatures range between 1400 to 1500 degrees Fahrenheit, depending on the shape and size of the tool to be hardened.

Quench in water.

Temper to suit conditions.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem XCL Tool Steel

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.	XCL	BETHLEHEM XCL TOOL STEEL

USES

Collets, cups, cones, drop forging dies, trimming dies, mining and quarrying drills, blacksmith tools, fullers, flatters, cold cutters, track tools, boilermakers' tools, hand and pneumatic chisels, caulking and beading tools, rivet sets, punches and dies, shear blades, and machine parts that require hardening.

TREATMENT

Hardening temperatures range between 1400 to 1500 degrees Fahrenheit, depending on the shape and size of the tool to be hardened.

Quench in water.

Temper to suit conditions.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem ⊗ Tool Steel

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.	BS	⊗ Bethlehem TOOL STEEL

USES

Quarrying tools, drills for soft rock, coal, etc., (for drilling hard rock, granite, etc., use Bethlehem XCL and Bethlehem XX grades). Also recommended for furnace bars, pinch bars, crow bars, chisel bars, agricultural chisels and tools, and drift pins.

TREATMENT

Hardening temperatures range between 1400 to 1500 degrees Fahrenheit, depending on the shape and size of the tool to be hardened.

Quench in water.

Temper to suit conditions.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem Tool Room Tool Steel

An Oil Hardening Tool Steel

IS UNIQUE

In that it combines non-shrinking and non-warping qualities with hardness and toughness.

HARDENS UNIFORMLY

The most economical steel for general tool room work.

UNIFORMLY ANNEALED

Use it for your Punching, Blanking, Trimming, Sub-press, Forming and Drawing Dies, Taps, Reamers, Broaches, Circular Cutters, Hobs, Master Tools of all kinds, Plug and Ring Thread Gauges.

ABSOLUTE SAFETY IN HARDENING

HARDENING

Preheat slowly to dark red; then heat gradually and uniformly to the proper hardening heat, which will be from

1375 to 1475 degrees Fahrenheit, or from a cherry red to a medium cherry, depending upon the size and character of the tool.

Quench in Oil — Fish, Linseed or Cotton Seed Oils Preferred. Dip carefully.

TEMPERING

Always draw Tool Room Steel to at least 300 degrees Fahrenheit, the point at which straw color begins to appear. Where extra toughness is required draw to not over 450 degrees Fahrenheit, or medium straw.

For General Instructions see page 19.

Extras for size and annealing, page 17.

Bethlehem Tough Tool Steel

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.	BETHLEHEM TOUGH TOOL STEEL

USES

An alloy steel possessing hardness and toughness, suitable for Cold Cutters, Flogging Chisels, Rivet and Button sets, Hand and Pneumatic Chipping Chisels.

TREATMENT

The hardening temperatures range between 1400 to 1500 degrees Fahrenheit, depending on the mass or section and hardness desired.

Quench in water.

This steel may also be made sufficiently hard for the above purposes by raising the hardening temperatures and quenching in oil.

To harden chisels, heat to 1425 to 1450 degrees Fahrenheit, and quench in water.

Temper to a straw color or until a sharp file takes hold bearing in mind that this steel when tempered to a straw color is of the same file hardness as a Carbon tool steel chisel tempered to a blue color.

Hardening instructions for other purposes will be furnished when shipment goes forward.

For General Instructions see page 19.

Extras for size and annealing, page 17.

State in detail the purpose for which the steel will be used

Bethlehem Piston Steel

BETHLEHEM STEEL COMPANY BETHLEHEM, PA.	BPS BETHLEHEM PISTON STEEL

USES

For pistons in pneumatic hammers.

REMARKS

The increasing use of pneumatic hammers and similar tools has created a demand for a steel which will withstand shock and the resulting fatigue. Bethlehem Piston Steel is highly recommended for uses of this character.

TREATMENT

The hardening temperature ranges between 1425 to 1475 degrees Fahrenheit, depending on the mass or section and depth of hardness desired.

Quench in water.

Temper to suit conditions.

For General Instructions see page 19.

Extras for size and annealing, page 17.

Bethlehem Crucible Special Alloy Steels

BETHLEHEM TWIST DRILL STEELS

Bethlehem Twist Drill Steels after countless practical tests have been found to meet the requirements of the modern heavy duty drilling machines with maximum speeds and feeds.

BETHLEHEM GAS ENGINE POPPET VALVE STEELS

Valves made of these steels retain their shape and hardness at high temperatures.

BETHLEHEM PERMANENT MAGNET STEELS

Bethlehem Permanent Magnet Steels have been developed for magnetoes and all instruments that require maximum magnetic strength.

BETHLEHEM CHROME BALL RACE STEELS

A water hardening steel for Cups, Cones, Thrust and Annular Ball-Bearings, Rollers, Roller Paths, etc. Thoroughly annealed and therefore, may be rapidly machined, and is in every respect far more durable than the case or pack hardening steels for this purpose.

BETHLEHEM No. 5 NICKEL STEEL
(25.00 to 30.00% Nickel)

Recommended for parts subjected to the corrosive influences of acids and water. Furnished black as rolled or cold drawn.

BETHLEHEM No. 6 NICKEL STEEL
(30.00 to 35.00% Nickel)

Recommended for instruments or parts where a very low co-efficient of expansion is desired. Furnished black as rolled or cold drawn.

IN ADDITION TO OUR STANDARD BRANDS OF SPECIAL ALLOY STEELS FOR THE ABOVE PURPOSES, WE ARE PREPARED TO FURNISH STEELS TO SPECIAL ANALYSES.

Bethlehem Hot Work Steels

Bethlehem "No. 57" Tool Steel
Bethlehem "No. 81" Tool Steel
Bethlehem "No. 445" Tool Steel
Bethlehem "No. 58" Tool Steel

USES

Alloy steels especially developed for hot work tools, and are recommended for the following purposes: Hot bolt, rivet, and spike heading gripper or open dies, and headers; hot nut crowners, piercers, and punches, hydraulic riveter dies or bulldozer dies, compression dies, shear blades, hot chipping chisels, etc.

Each one of these steels has been developed for a special purpose and to meet various conditions, therefore, to give you the benefit of our experience, and to select the one steel that will give best results in your shop, please state in detail the nature of the work, i. e., whether high or low carbon steel or iron bolts, nuts, rivets, etc.—a rough sketch of the tools with approximate dimensions, would assist us materially in recommending the grade best adapted and its treatment.

HEAT TREATMENT

Bethlehem No. 57 and 58 Tool Steels are air or oil hardening steels; Bethlehem No. 81 and 445 Tool Steels may

be hardened in air, oil, or water, depending upon conditions. Specific hardening instructions will be given when shipment goes forward.

ANNEALING

Bethlehem No. 57 and 58, same as Bethlehem Special High Speed Steel shown on page 11.

Bethlehem No. 81 and 445 same as Carbon Tool Steels shown on page 20.

Extras for size and annealing, No. 81, No. 57, No. 58, Page 15.

Extras for size and annealing, No. 445, page 17.

State in detail the purpose for which the steel will be used

Tool Steel Discs

We are prepared to furnish DISCS of all our grades of tool steel, for milling cutters, drawing dies, rolls, etc.

WEIGHT OF TOOL STEEL DISCS

The estimated weight of tool steel discs 1 inch wide, up to and including 48 inches in diameter, are shown on pages 36 and 39.

To find the estimated weight of a disc with a width greater than 1 inch, multiply the weight per inch by the width of disc in inches.

For weight of High Speed Tool Steel Discs add 10%.

The size ordered will be furnished unless it is specified that an allowance for finish is desired.

Extras for size and annealing High Speed, page 16.

Extras for size and annealing Tool Steel, page 18.

WEIGHT OF ROUND STEEL PER RUNNING INCH

Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.
0		0	2.01	0	8.03	0	18.07
1/16		1/16	2.09	1/16	8.20	1/16	18.32
1/8		1/8	2.18	1/8	8.37	1/8	18.58
3/16		3/16	2.27	3/16	8.54	3/16	18.83
1/4	.01	1/4	2.36	1/4	8.71	1/4	19.09
5/16	.02	5/16	2.45	5/16	8.89	5/16	19.34
3/8	.03	3/8	2.54	3/8	9.07	3/8	19.61
0 7/16	.04	3 7/16	2.64	6 7/16	9.25	9 7/16	19.87
1/2	.06	1/2	2.73	1/2	9.43	1/2	20.13
9/16	.07	9/16	2.83	9/16	9.61	9/16	20.40
5/8	.09	5/8	2.93	5/8	9.79	5/8	20.67
11/16	.11	11/16	3.03	11/16	9.98	11/16	20.93
3/4	.13	3/4	3.14	3/4	10.16	3/4	21.21
13/16	.15	13/16	3.24	13/16	10.35	13/16	21.48
7/8	.17	7/8	3.35	7/8	10.54	7/8	21.76
15/16	.20	15/16	3.46	15/16	10.74	15/16	22.03
0	.22	0	3.57	0	10.93	0	22.31
1/16	.25	1/16	3.68	1/16	11.13	1/16	22.59
1/8	.28	1/8	3.80	1/8	11.33	1/8	22.87
3/16	.31	3/16	3.91	3/16	11.52	3/16	23.15
1/4	.35	1/4	4.03	1/4	11.73	1/4	23.44
5/16	.38	5/16	4.14	5/16	11.93	5/16	23.72
3/8	.42	3/8	4.27	3/8	12.13	3/8	24.01
1 7/16	.46	4 7/16	4.39	7 7/16	12.34	10 7/16	24.30
1/2	.50	1/2	4.52	1/2	12.55	1/2	24.60
9/16	.54	9/16	4.64	9/16	12.76	9/16	24.89
5/8	.59	5/8	4.77	5/8	12.97	5/8	25.19
11/16	.64	11/16	4.90	11/16	13.18	11/16	25.48
3/4	.68	3/4	5.03	3/4	13.40	3/4	25.78
13/16	.73	13/16	5.17	13/16	13.61	13/16	26.08
7/8	.78	7/8	5.30	7/8	13.84	7/8	26.39
15/16	.84	15/16	5.44	15/16	14.05	15/16	26.68
0	.89	0	5.58	0	14.28	0	27.00
1/16	.95	1/16	5.72	1/16	14.50	1/16	27.30
1/8	1.01	1/8	5.86	1/8	14.73	1/8	27.61
3/16	1.07	3/16	6.00	3/16	14.95	3/16	27.92
1/4	1.13	1/4	6.15	1/4	15.18	1/4	28.24
5/16	1.19	5/16	6.30	5/16	15.41	5/16	28.54
3/8	1.26	3/8	6.45	3/8	15 65	3/8	28.87
2 7/16	1.33	5 7/16	6.60	8 7/16	15.88	11 7/16	29.19
1/2	1.39	1/2	6.75	1/2	16.12	1/2	29.50
9/16	1.46	9/16	6.90	9/16	16.36	9/16	29.83
5/8	1.54	5/8	7.06	5/8	16.60	5/8	30.15
11/16	1.61	11/16	7.22	11/16	16.83	11/16	30.47
3/4	1.69	3/4	7.38	3/4	17.08	3/4	30.80
13/16	1.76	13/16	7.54	13/16	17.32	13/16	31.12
7/8	1.84	7/8	7.70	7/8	17.57	7/8	31.46
15/16	1.92	15/16	7.86	15/16	17.82	15/16	31.79

FOR HIGH SPEED STEEL ADD 10 PER CENT.

WEIGHT OF ROUND STEEL PER RUNNING INCH

Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.
0	32.13	0	50.19	0	72.27	0	98.37
1/16	32.46	1/16	50.61	1/16	72.77	1/16	98.94
1/8	32.80	1/8	51.03	1/8	73.28	1/8	99.54
3/16	33.13	3/16	51.45	3/16	73.78	3/16	100.13
1/4	33.48	1/4	51.87	1/4	74.29	1/4	100.72
5/16	33.81	5/16	52.30	5/16	74.80	5/16	101.32
3/8	34.17	3/8	52.73	3/8	75.31	3/8	101.91
12 7/16	34.51	15 7/16	53.16	18 7/16	75.82	21 7/16	102.51
1/2	34.86	1/2	53.59	1/2	76.34	1/2	103.11
9/16	35.21	9/16	54.02	9/16	76.86	9/16	103.71
5/8	35.56	5/8	54.46	5/8	77.38	5/8	104.31
11/16	35.91	11/16	54.89	11/16	77.90	11/16	104.91
3/4	36.27	3/4	55.33	3/4	78.42	3/4	105.52
13/16	36.62	13/16	55.77	13/16	78.94	13/16	106.13
7/8	36.98	7/8	56.21	7/8	79.47	7/8	106.73
15/16	37.33	15/16	56.66	15/16	79.99	15/16	107.35
0	37.70	0	57.10	0	80.52	0	107.96
1/16	38.06	1/16	57.55	1/16	81.05	1/16	108.57
1/8	38.42	1/8	57.99	1/8	81.59	1/8	109.19
3/16	38.79	3/16	58.45	3/16	82.12	3/16	109.81
1/4	39.16	1/4	58.90	1/4	82.66	1/4	110.43
5/16	39.53	5/16	59.35	5/16	83.19	5/16	111.05
3/8	39.90	3/8	59.81	3/8	83.73	3/8	111.67
13 7/16	40.28	16 7/16	60.27	19 7/16	84.27	22 7/16	112.29
1/2	40.65	1/2	60.73	1/2	84.82	1/2	112.92
9/16	41.03	9/16	61.19	9/16	85.36	9/16	113.55
5/8	41.41	5/8	61.65	5/8	85.91	5/8	114.18
11/16	41.79	11/16	62.11	11/16	86.45	11/16	114.81
3/4	42.17	3/4	62.58	3/4	87.00	3/4	115.44
13/16	42.56	13/16	63.05	13/16	87.56	13/16	116.08
7/8	42.94	7/8	63.52	7/8	88.11	7/8	116.72
15/16	43.33	15/16	63.99	15/16	88.66	15/16	117.35
0	43.72	0	64.46	0	89.22	0	118 00
1/16	44.11	1/16	64.94	1/16	89.78	1/16	118.64
1/8	44.50	1/4	65.41	1/8	90.34	1/8	119.28
3/16	44.90	3/16	65.89	3/16	90.90	3/16	119.93
1/4	45.29	1/4	66.37	1/4	91.47	1/4	120.57
5/16	45.69	5/16	66.85	5/16	92.03	5/16	121.22
3/8	46.09	3/8	67.34	3/8	92.60	3/8	121.87
14 7/16	46.49	17 7/16	67.82	20 7/16	93.17	23 7/16	122.52
1/2	46.90	1/2	68.31	1/2	93.74	1/2	123.18
9/16	47.30	9/16	68.80	9/16	94.31	9/16	123.84
5/8	47.71	5/8	69.29	5/8	94.88	5/8	124.50
11/16	48.12	11/16	69.78	11/16	95.46	11/16	125.15
3/4	48.53	3/4	70.28	3/4	96.04	3/4	125.82
13/16	48.94	13/16	70.77	13/16	96.62	13/16	126.48
7/8	49.35	7/8	71.27	7/8	97.20	7/8	127.14
15/16	49.77	15/16	71.77	15/16	97.78	15/16	127.81

FOR HIGH SPEED STEEL ADD 10 PER CENT.

WEIGHT OF ROUND STEEL PER RUNNING INCH

Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.
0	128.48	0	162.61	0	200.75	0	242.91
1/16	129.17	1/16	163.36	1/16	201.58	1/16	243.82
1/8	129.82	1/8	164.12	1/8	202.42	1/8	244.75
3/16	130.49	3/16	164.87	3/16	203.27	3/16	245.67
1/4	131.17	1/4	165.63	1/4	204.11	1/4	246.60
5/16	131.85	5/16	166.39	5/16	204.95	5/16	247.53
3/8	132.53	3/8	167.15	3/8	205.80	3/8	248.46
7/16	133.20	7/16	167.92	7/16	206.64	7/16	249.38
24 1/2	133.89	**27** 1/2	168.68	**30** 1/2	207.50	**33** 1/2	250.32
9/16	134.57	9/16	169.45	9/16	208.34	9/16	251.25
5/8	135.26	5/8	170.22	5/8	209.20	5/8	252.19
11/16	135.94	11/16	170.99	11/16	210.05	11/16	253.13
3/4	136.63	3/4	171.77	3/4	210.91	3/4	254.07
13/16	137.32	13/16	172.54	13/16	211.77	13/16	255.01
7/8	138.02	7/8	173.32	7/8	212.63	7/8	255.96
15/16	138.71	15/16	174.09	15/16	213.49	15/16	256.90
0	139.41	0	174.87	0	214.35	0	257.85
1/16	140.10	1/16	175.65	1/16	215.22	1/16	258.79
1/8	140.81	1/8	176.44	1/8	216.09	1/8	259.75
3/16	141.51	3/16	177.22	3/16	216.95	3/16	260.70
1/4	142.21	1/4	178.01	1/4	217.83	1/4	261.66
5/16	142.92	5/16	178.80	5/16	218.70	5/16	262.61
3/8	143.62	3/8	179.59	3/8	219.57	3/8	263.57
7/16	144.33	7/16	180.38	7/16	220.44	7/16	264.52
25 1/2	145.04	**28** 1/2	181.18	**31** 1/2	221.32	**34** 1/2	265.49
9/16	145.75	9/16	181.97	9/16	222.20	9/16	266.45
5/8	146.47	5/8	182.77	5/8	223.08	5/8	267.42
11/16	147,18	11/16	183.57	11/16	223.97	11/16	268.38
3/4	147.90	3/4	184.37	3/4	224.85	3/4	269.35
13/16	148.62	13/16	185.17	13/16	225.74	13/16	270.32
7/8	149.34	7/8	185.97	7/8	226.63	7/8	271.29
15/16	150.06	15/16	186.78	15/16	227.51	15/16	272.27
0	150.78	0	187.59	0	228.41	0	273.24
1/16	151.51	1/16	188.39	1/16	229.30	1/16	274.21
1/8	152.24	1/8	189.21	1/8	230.19	1/8	275.20
3/16	152.97	3/16	190.02	3/16	231.09	3/16	276.18
1/4	153.70	1/4	190.84	1/4	231.99	1/4	277.16
5/16	154.43	5/16	191.65	5/16	232.89	5/16	278.14
3/8	155.17	3/8	192.47	3/8	233.79	3/8	279.13
7/16	155.90	7/16	193.29	7/16	234.69	7/16	280.11
26 1/2	156.64	**29** 1/2	194.11	**32** 1/2	235.60	**35** 1/2	281.10
9/16	157.38	9/16	194.93	9/16	236.50	9/16	282.09
5/8	158.12	5/8	195.76	5/8	237.42	5/8	283.09
11/16	158.86	11/16	196.59	11/16	238.33	11/16	284.08
3/4	159.61	3/4	197.42	3/4	239.24	3/4	285.08
13/16	160.36	13/16	198.25	13/16	240.15	13/16	286.07
7/8	161.10	7/8	199.08	7/8	241.07	7/8	287.07
15/16	161.85	15/16	199.91	15/16	241.99	15/16	288.07

FOR HIGH SPEED STEEL ADD 10 PER CENT.

WEIGHT OF ROUND STEEL PER RUNNING INCH

Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.	Diam.	Lbs.
0	289.08	0	339.26	0	393.47	0	451.68
1/16	290.08	1/16	340.35	1/16	394.63	1/16	452.93
1/8	291.09	1/8	341.44	1/8	395.81	1/8	454.20
3/16	292.10	3/16	342.53	3/16	396.99	3/16	455.45
1/4	293.11	1/4	343.63	1/4	398.17	1/4	456.72
5/16	294.12	5/16	344.72	5/16	399.34	5/16	457.98
3/8	295.13	3/8	345.82	3/8	400.53	3/8	459.24
36 7/16	296.14	39 7/16	346.91	42 7/16	401.70	45 7/16	460.50
1/2	297.16	1/2	348.02	1/2	402.89	1/2	461.78
9/16	298.18	9/16	349.12	9/16	404.07	9/16	463.04
5/8	299.20	5/8	350.23	5/8	405.27	5/8	464.32
11/16	300.22	11/16	351.33	11/16	406.45	11/16	465.59
3/4	301.25	3/4	352.44	3/4	407.65	3/4	466.85
13/16	302.27	13/16	353.55	13/16	408.84	13/16	468.14
7/8	303.30	7/8	354.66	7/8	410.03	7/8	469.42
15/16	304.33	15/16	355.77	15/16	411.23	15/16	470.70
0	305.36	0	356.89	0	412.42	0	471.98
1/16	306.39	1/16	358.00	1/16	413.62	1/16	473.26
1/8	307.43	1/8	359.12	1/8	414.83	1/8	474.55
3/16	308.46	3/16	360.24	3/16	416.03	3/16	475.84
1/4	309.50	1/4	361.36	1/4	417.24	1/4	477.13
5/16	310.54	5/16	362.48	5/16	418.44	5/16	478.42
3/8	311.58	3/8	363.61	3/8	419.65	3/8	479.71
37 7/16	312.62	40 7/16	364.73	43 7/16	420.85	46 7/16	480.99
1/2	313.67	1/2	365.86	1/2	422.07	1/2	482.30
9/16	314.71	9/16	366.99	9/16	423.28	9/16	483.59
5/8	315.76	5/8	368.13	5/8	424.50	5/8	484.89
11/16	316.81	11/16	369.26	11/16	425.72	11/16	486.19
3/4	317.87	3/4	370.39	3/4	426.94	3/4	487.50
13/16	318.92	13/16	371.53	13/16	428.16	13/16	488.80
7/8	319.97	7/8	372.67	7/8	429.38	7/8	490.11
15/16	321.03	15/16	373.81	15/16	430.60	15/16	491.41
0	322.09	0	374.95	0	431.83	0	492.73
1/16	323.14	1/16	376.09	1/16	433.05	1/16	494.03
1/8	324.21	1/8	377.24	1/8	434.29	1/8	495.35
3/16	325.27	3/16	378.39	3/16	435.52	3/16	496.66
1/4	326.34	1/4	379.54	1/4	436.75	1/4	497.98
5/16	327.41	5/16	380.69	5/16	437.99	5/16	499.30
3/8	328.48	3/8	381.84	3/8	439.22	3/8	500.62
38 7/16	329.54	41 7/16	382.99	44 7/16	440.45	47 7/16	501.93
1/2	330.62	1/2	384.15	1/2	441.70	1/2	503.26
9/16	331.69	9/16	385.31	9/16	442.94	9/16	504.58
5/8	332.77	5/8	386.47	5/8	444.19	5/8	505.92
11/16	333.85	11/16	387.63	11/16	445.43	11/16	507.24
3/4	334.93	3/4	388.80	3/4	446.68	3/4	508.58
13/16	336.01	13/16	389.96	13/16	447.93	13/16	509.91
7/8	337.09	7/8	391.13	7/8	449.18	7/8	511.24
15/16	338.18	15/16	392.29	15/16	450.43	15/16	512.58
						48 0	513.91

FOR HIGH SPEED STEEL ADD 10 PER CENT.

Decimal Equivalents of Fractions of an Inch

1/64	.015625
1/32	.03125
3/64	.046875
1/16	.0625
5/64	.078125
3/32	.09375
7/64	.109375
1/8	.125
9/64	.140625
5/32	.15625
11/64	.171875
3/16	.1875
13/64	.203125
7/32	.21875
15/64	.234375
1/4	.25
17/64	.265625
9/32	.28125
19/64	.296875
5/16	.3125
21/64	.328125
11/32	.34375
23/64	.359375
3/8	.375
25/64	.390625
13/32	.40625
27/64	.421875
7/16	.4375
29/64	.453125
15/32	.46875
31/64	.484375
1/2	.50
33/64	.515625
17/32	.53125
35/64	.546875
9/16	.5625
37/64	.578125
19/32	.59375
39/64	.609375
5/8	.625
41/64	.640625
21/32	.65625
43/64	.671875
11/16	.6875
45/64	.703125
23/32	.71875
47/64	.734375
3/4	.75
49/64	.765625
25/32	.78125
51/64	.796875
13/16	.8125
53/64	.828125
27/32	.84375
53/64	.859375
7/8	.875
57/64	.890625
29/32	.90625
59/64	.921875
15/16	.9375
61/64	.953125
31/32	.96875
63/64	.984375
1"	100

FLAT BAR STEEL—Weight Per Lineal Foot

	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2	2¼	2½
⅛	.213	.266	.320	.372	.426	.479	.530	.585	.640	.745	.850	.955	1.07
3/16	.319	.399	.480	.558	.639	.718	.790	.878	.960	1.12	1.28	1.43	1.60
¼	.425	.533	.640	.743	.852	.958	1.06	1.17	1.28	1.49	1.70	1.91	2.13
5/16	.531	.665	.800	.929	1.06	1.20	1.33	1.46	1.60	1.86	2.13	2.39	2.66
⅜	.638	.798	.960	1.12	1.28	1.33	1.59	1.75	1.91	2.23	2.55	2.87	3.20
7/16	.744	.931	1.12	1.30	1.49	1.67	1.86	2.05	2.33	2.60	2.98	3.35	3.72
½	.....	1.07	1.28	1.49	1.70	1.91	2.13	2 34	2.55	2.98	3.40	3.83	4.26
9/16	.....	1.20	1.44	1.67	1.91	2.15	2.39	2.63	2.87	3.35	3.83	4.30	4.78
⅝	.....	.....	1.60	1.86	2.12	2.39	2.66	2.92	3.19	3.72	4.26	4.79	5.32
11/16	.....	.....	1.76	2.04	2.34	2.63	2.92	3.22	3.51	4.09	4.68	5.26	5.84
¾	.....	.....	.....	2.23	2.55	2.86	3.19	3.50	3.83	4.46	5.10	5.74	6.40
13/16	.....	.....	.....	2.41	2.76	3.11	3.45	3.80	4.14	4.83	5.53	6.22	6.91
⅞	.....	.....	.....	.....	2.98	3.34	3.72	4.09	4.46	5.21	5.96	6.70	7.46
15/16	.....	.....	.....	.....	3.19	3.59	3.98	4.38	4.78	5.58	6.38	7.17	7.97
1	.....	.....	.....	.....	.....	3.82	4.25	4.68	5.10	5.96	6.80	7.66	8.52
1 ⅛	.....	.....	.....	.....	.....	.....	4.78	5.27	5.74	6.71	7.65	8.61	9.59
1 ¼	.....	.....	.....	.....	.....	.....	.....	5.85	6.38	7.45	8.50	9.57	10.65
1 ½	.....	.....	.....	.....	.....	.....	.....	7.02	7.67	8.94	10.21	11.49	12.78

FLAT BAR STEEL—Continued. Weight Per Lineal Foot

	2¾	3	3½	4	5	6	7	8	9	10	11	12
1/8	1.18	1.28	1.49	1.70	2.13	2.56	2.98	3.40	3.84	4.26	4.68	5.10
3/16	1.76	1.92	2.24	2.55	3.20	3.83	4.47	5.10	5.74	6.38	7.02	7.65
1/4	2.34	2.56	2.98	3.40	4.26	5.11	5.96	6.80	7.65	8.50	9.34	10.20
5/16	2.92	3.19	3.72	4.25	5.32	6.38	7.44	8.50	9.56	10.62	11.68	12.75
3/8	3.51	3.83	4.46	5.10	6.40	7.66	8.92	10.20	11.48	12.75	14.03	15.30
7/16	4.09	4.46	5.21	5.95	7.44	8.92	10.40	11.90	13.40	14.88	16.36	17.85
1/2	4.68	5.10	5.96	6.80	8.52	10.20	11.90	13.60	15.30	17.00	18.70	20.40
9/16	5.26	5.74	6.69	7.65	9.56	11.50	13.40	15.30	17.22	19.14	21.02	22.95
5/8	5.86	6.39	7.44	8.52	10.64	12.78	14.90	17.00	19.13	21.25	23.38	25.50
11/16	6.43	7.01	8.18	9.35	11.70	14.00	16.40	18.70	21.04	23.38	25.70	28.05
3/4	7.02	7.65	8.92	10.20	12.80	15.30	17.90	20.40	22.96	25.50	28.05	30.60
13/16	7.60	8.29	9.67	11.10	13.80	16.60	19.30	22.10	24.86	27.62	30.40	33.15
7/8	8.19	8.94	10.42	11.92	14.92	17.88	20.80	23.80	26.78	29.75	32.72	35.70
15/16	8.77	9.56	11.20	12.80	15.90	19.10	22.40	25.50	28.69	31.88	33.06	38.25
1	9.36	10.20	11.92	13.60	17.04	20.40	23 80	27.20	30.60	34.00	37.40	40.80
1 1/8	10.54	11.48	13.41	15.30	19.17	22.95	26.80	30.60	34.43	38.25	42.08	45.90
1 1/4	11 71	12.76	14.90	17.00	21.30	25.61	29.76	34.00	38.26	42.50	46.76	51.00
1 1/2	14.04	15.30	17.88	20.40	25.56	30.60	35.70	40.80	45.90	51.00	56.10	61.20

Temperatures

DEGREES FAHRENHEIT AND CORRESPONDING CENTIGRADE

F.	C.	F.	C.	F.	C.
32	0	1040	560	1740	949
212	100	1060	571	1760	960
400	204	1080	582	1780	971
420	216	1100	593	1800	982
440	227	1120	604	1820	993
460	238	1140	615	1840	1004
480	249	1160	626	1860	1015
500	260	1180	637	1880	1026
520	271	1200	648	1900	1038
540	282	1220	659	1920	1049
560	293	1240	670	1940	1060
580	305	1260	681	1960	1071
600	316	1280	693	1980	1082
620	327	1300	705	2000	1093
640	338	1320	716	2020	1105
660	349	1340	727	2040	1116
680	360	1360	738	2060	1127
700	371	1380	749	2080	1138
720	382	1400	760	2100	1149
740	393	1420	771	2120	1160
760	405	1440	782	2140	1171
780	416	1460	793	2160	1182
800	427	1480	804	2180	1193
820	438	1500	816	2200	1204
840	449	1520	827	2220	1216
860	460	1540	838	2240	1227
880	471	1560	849	2260	1238
900	482	1580	860	2280	1249
920	493	1600	871	2300	1260
940	504	1620	882	2320	1271
960	516	1640	893	2340	1283
980	527	1660	904	2360	1294
1000	538	1680	915	2380	1305
1020	549	1700	927	2400	1316

Temperatures

DEGREES CENTIGRADE AND CORRESPONDING FAHRENHEIT

C.	F.	C.	F.	C.	F.
0	32	520	968	860	1580
100	212	530	986	870	1598
200	392	540	1004	880	1616
210	410	550	1022	890	1634
2 0	428	560	1040	900	1652
230	446	570	1058	910	1670
240	464	580	1076	920	1688
250	482	590	1094	930	1706
260	500	600	1112	940	1724
270	518	610	1130	950	1742
280	536	620	1148	960	1760
290	554	630	1166	970	1778
300	572	640	1184	980	1796
310	590	650	1202	990	1814
320	608	660	1220	1000	1832
330	626	670	1238	1010	1850
340	644	680	1256	1020	1868
350	662	690	1274	1030	1886
360	680	700	1292	1040	1904
370	698	710	1310	1050	1922
380	716	720	1328	1060	1940
390	734	730	1346	1070	1958
400	752	740	1364	1080	1976
410	770	750	1382	1090	1994
420	788	760	1400	1100	2012
430	806	770	1418	1110	2030
440	824	780	1436	1120	2048
450	842	790	1454	1130	2066
460	860	800	1472	1140	2084
470	878	810	1490	1150	2102
480	896	820	1508	1160	2120
490	914	830	1526	1170	2138
500	932	840	1544	1180	2156
510	950	850	1562	1190	2174

Incandescent Colors and Temperatures

Taylor & White's Table

	Fahr.	Cent.
Black Red	990	533
Dark Blood Red	1050	565
Dark Cherry Red	1175	634
Medium Cherry Red	1250	676
Full Cherry Red	1375	745
Light Cherry, Scaling	1550	843
Salmon, Free Scaling	1650	899
Light Salmon	1725	940
Yellow	1825	995
Light Yellow	1975	1078
White	2220	1203

Table of Temper Colors of Carbon Steel Commonly Accepted as Standard

	Woodworth	Haswell	
	°F	°F	°C
Very Light Yellow	420	.....	.....
Faint Yellow	430	430	221
Straw Color	460	460	238
Dark Straw	470	470	243
Dark Yellow	490	.....	255
Brown Yellow	500	.....	260
Spotted Red Brown	510	.....	265
Purple	530	530	277
Blue	550	550	289
Full Blue	560	560	293
Polish Blue	580	580	304
Dark Blue	600	600	316

Table of Brinell Hardness Numerals

STEEL BALL OF 10 MM. DIAMETER

Diam. of Impression mm.	Hardness Numeral Pressure kg. 3000	500	Diam. of Impression mm.	Hardness Numeral Pressure kg. 3000	500
2,--	946	158	3,25	351	59
2,05	898	150	3,30	340	57
2,10	857	143	3,35	332	55
2,15	817	136	3,40	321	54
2,20	782	130	3,45	311	52
2,25	744	124	3,50	302	50
2,30	713	119	3,55	293	49
2,35	683	114	3,60	286	48
2,40	652	109	3,65	277	46
2,45	627	105	3,70	269	45
2,50	600	100	3,75	262	44
2,55	578	96	3,80	255	43
2,60	555	93	3,85	248	41
2,65	532	89	3,90	241	40
2,70	512	86	3,95	235	39
2,75	495	83			
2,80	477	80	4,--	228	38
2,85	460	77	4,05	223	37
2,90	444	74	4,10	217	36
2,95	430	72	4,15	212	35
			4,20	207	34,5
3,--	418	70	4,25	202	33,6
3,05	402	67	4,30	196	32,6
3,10	387	65	4,35	192	32
3,15	375	63	4,40	187	31,2
3,20	364	61	4,45	183	30,4

Table of Brinell Hardness Numerals

STEEL BALL OF 10 MM. DIAMETER

Diam. of Impression mm.	Hardness Numeral Pressure kg. 3000	500	Diam. of Impression mm.	Hardness Numeral Pressure kg. 3000	500
4,50	179	29,7	5,75	105	17,5
4,55	174	29,1	5,80	103	17,2
4,60	170	28,4	5,85	101	16,9
4,65	166	27,8	5,90	99	16,6
4,70	163	27,2	5,95	97	16,2
4,75	159	26,5			
4,80	156	25,9	6,--	95	15,9
4,85	153	25,4	6,05	94	15,6
4,90	149	24,9	6,10	92	15,3
4,95	146	24,4	6,15	90	15,1
			6,20	89	14,8
5,--	143	23,8	6,25	87	14,5
5,05	140	23,3	6,30	86	14,3
5,10	137	22,8	6,35	84	14
5,15	134	22,3	6,40	82	13,8
5,20	131	21,8	6,45	81	13,5
5,25	128	21,5	6,50	80	13,3
5,30	126	21	6,55	79	13,1
5,35	124	20,6	6,60	77	12,8
5,40	121	20,1	6,65	76	12,6
5,45	118	19,7	6,70	74	12,4
5,50	116	19,3	6,75	73	12,2
5,55	114	19	6,80	71,5	11,9
5,60	112	18,6	6,85	70	11,7
5,65	109	18,2	6,90	69	11,5
5,70	107	17,8	6,95	68	11,3

Decimal Equivalents of Millimeters

mm.	Inches	mm.	Inches	mm.	Inches	mm.	Inches
1 =	.03937	31 =	1.22047	61 =	2.40157	91 =	3.58267
2 =	.07874	32 =	1.25984	62 =	2.44094	92 =	3.62204
3 =	.11811	33 =	1.29921	63 =	2.48031	93 =	3.66141
4 =	.15748	34 =	1.33858	64 =	2.51968	94 =	3.70078
5 =	.19685	35 =	1.37795	65 =	2.55905	95 =	3.74015
6 =	.23622	36 =	1.41732	66 =	2.59842	96 =	3.77952
7 =	.27559	37 =	1.45669	67 =	2.63779	97 =	3.81889
8 =	.31496	38 =	1.49606	68 =	2.67716	98 =	3.85826
9 =	.35433	39 =	1.53543	69 =	2.71653	99 =	3.89763
10 =	.39370	40 =	1.57480	70 =	2.75590	100 =	3.93700
11 =	.43307	41 =	1.61417	71 =	2.79527		
12 =	.47244	42 =	1.65354	72 =	2.83464		
13 =	.51181	43 =	1.69291	73 =	2.87401		
14 =	.55118	44 =	1.73228	74 =	2.91338		
15 =	.59055	45 =	1.77165	75 =	2.95275		
16 =	.62992	46 =	1.81102	76 =	2.99212		
17 =	.66929	47 =	1.85039	77 =	3.03149		
18 =	.70866	48 =	1.88976	78 =	3.07086		
19 =	.74803	49 =	1.92913	79 =	3.11023		
20 =	.78740	50 =	1.96850	80 =	3.14960		
21 =	.82677	51 =	2.00787	81 =	3.18897	1 mm. =	0.03937 in.
22 =	.86614	52 =	2.04724	82 =	3.22834	1 cm. =	0.3937 "
23 =	.90551	53 =	2.08661	83 =	3.26771	1 dm. =	3.937 "
24 =	.94488	54 =	2.12598	84 =	3.30708	1 m. =	39.37 "
25 =	.98425	55 =	2.16535	85 =	3.34645		
26 =	1.02362	56 =	2.20472	86 =	3.38582		
27 =	1.06299	57 =	2.24409	87 =	3.42519		
28 =	1.10236	58 =	2.28346	88 =	3.46456		
29 =	1.14173	59 =	2.32283	89 =	3.50393		
30 =	1.18110	60 =	2.36220	90 =	3.54330		

BAR STEEL

WEIGHT PER LINEAL FOOT

One Cubic Foot Weighing 489.54 Pounds

SQUARE		ROUND		OCTAGON		HEXAGON	
Inch	Pounds	Inch	Pounds	Inch	Pounds	Inch	Pounds
1/32	.003	1/32	.0026	1/32	.0227	1/32	.0029
1/16	.013	1/16	.0104	1/16	.011	1/16	.0115
1/8	.05	1/8	.042	1/8	.044	1/8	.046
3/16	.12	3/16	.09	3/16	.094	3/16	.10
1/4	.21	1/4	.17	1/4	.18	1/4	.19
5/16	.33	5/16	.26	5/16	.27	5/16	.29
3/8	.48	3/8	.38	3/8	.40	3/8	.42
7/16	.65	7/16	.51	7/16	.54	7/16	.56
1/2	.85	1/2	.67	1/2	.71	1/2	.74
9/16	1.08	9/16	.85	9/16	.90	9/16	.94
5/8	1.33	5/8	1.04	5/8	1.10	5/8	1.15
11/16	1.61	11/16	1.27	11/16	1.34	11/16	1.40
3/4	1.92	3/4	1.50	3/4	1.58	3/4	1.65
13/16	2.24	13/16	1.76	13/16	1.86	13/16	1.94
7/8	2.60	7/8	2.04	7/8	2.15	7/8	2.25
15/16	3.06	15/16	2.35	15/16	2.48	15/16	2.59
1	3.40	1	2.67	1	2.82	1	2.94
1/16	3.84	1/16	3.01	1/16	3.17	1/16	3.31
1/8	4.30	1/8	3.38	1/8	3.56	1/8	3.73
3/16	4.80	3/16	3.77	3/16	3.98	3/16	4.16
1/4	5.31	1/4	4.17	1/4	4.40	1/4	4.60
5/16	5.86	5/16	4.60	5/16	4.85	5/16	5.07
3/8	6.43	3/8	5.02	3/8	5.29	3/8	5.54
7/16	7.03	7/16	5.52	7/16	5.82	7/16	9.09

For HIGH SPEED STEEL, add 10 per cent. to listed weights

BAR STEEL

WEIGHT PER LINEAL FOOT—Continued

SQUARE		ROUND		OCTAGON		HEXAGON	
Inch	Pounds	Inch	Pounds	Inch	Pounds	Inch	Pounds
1½	7.65	1½	6.01	1½	6.32	1½	5.63
9/16	8.30	9/16	6.52	9/16	6.88	9/16	7.19
5/8	8.98	5/8	7.05	5/8	7.44	5/8	7.77
11/16	9.68	11/16	7.60	11/16	8.02	11/16	8.38
¾	10.41	¾	8.18	¾	8.63	¾	9.02
13/16	11.17	13/16	8.77	13/16	9.25	13/16	9.67
⅞	11.95	⅞	9.39	⅞	9.90	⅞	10.35
15/16	12.76	15/16	10.02	15/16	10.57	15/16	11.05
2	13.60	2	10.68	2	11.26	2	11.78
1/16	14.46	1/16	11.36	1/16	11.98	1/16	12.53
⅛	15.35	⅛	12.06	⅛	12.72	⅛	13.30
3/16	16.27	3/16	12.78	3/16	13.48	3/16	14.09
¼	17.22	¼	13.52	¼	14.26	¼	14,91
5/16	18.19	5/16	14.28	5/16	15.06	5/16	15.75
⅜	19.18	⅜	15.07	⅜	15.89	⅜	16.62
7/16	20.20	7/16	15.86	7/16	16.73	7/16	17.49
½	21.25	½	16.69	½	17.60	½	18.40
9/16	22.33	9/16	17.53	9/16	18.49	9/16	19.33
⅝	23.43	⅝	18.40	⅝	19.41	⅝	20.29
11/16	24.56	11/16	19.29	11/16	20.35	11/16	21.27
¾	25.00	¾	20.20	¾	21.30	¾	22,27
13/16	26.90	13/16	21.12	13/16	22.28	13/16	23.29
⅞	28.10	⅞	22.07	⅞	23.28	⅞	24.33
15/16	29.43	15/16	23.04	15/16	24.30	15/16	25.40

For HIGH SPEED STEEL, add 10 per cent. to listed weights

BAR STEEL

WEIGHT PER LINEAL FOOT—Continued

SQUARE		ROUND		OCTAGON	
Inch	Pounds	Inch	Pounds	Inch	Pounds
3	30.60	3	24.03	3	25.34
1/16	31.89	1/16	25.04	1/16	26.41
1/8	33.20	1/8	26.08	1/8	27.51
3/16	34.55	3/16	27.13	3/16	28.61
1/4	35.92	1/4	28.20	1/4	29.74
5/16	37.31	5/16	29.30	5/16	30.90
3/8	38.73	3/8	30.42	3/8	32.08
7/16	40.18	7/16	31.56	7/16	33.29
1/2	41.65	1/2	32.71	1/2	34.50
9/16	43.14	9/16	33.90	9/16	35.75
5/8	44.68	5/8	35.09	5/8	37.01
11/16	46.24	11/16	36.31	11/16	38.30
3/4	47.82	3/4	37.56	3/4	39.61
13/16	49.42	13/16	38.81	13/16	40.93
7/8	51.05	7/8	40.10	7/8	42.29
15/16	52.71	15/16	41.40	15/16	43.66
4	54.40	4	42.73	4	45.07
1/16	56.11	1/16	44.07	1/16	46.48
1/8	57.85	1/8	45.44	1/8	47.93
3/16	59.62	3/16	46.83	3/16	49.39
1/4	61.41	1/4	48.24	1/4	50.88
5/16	63.23	5/16	49.66	5/16	52.38
3/8	65.08	3/8	51.11	3/8	53.91
7/16	66.95	7/16	52.58	7/16	55.46

For HIGH SPEED STEEL, add 10 per cent. to listed weights

BAR STEEL

WEIGHT PER LINEAL FOOT—Continued

SQUARE		ROUND		OCTAGON	
Inch	Pounds	Inch	Pounds	Inch	Pounds
4 1/2	68.85	4 1/2	54.07	4 1/2	57.03
9/16	70.78	9/16	55.59	9/16	58.63
5/8	72.73	5/8	57.12	5/8	60.24
11/16	74.70	11/16	58.67	11/16	61.88
3/4	76.71	3/4	60.25	1/4	63.55
13/16	78.74	13/16	61.84	13/16	65.22
7/8	80.81	7/8	63.46	7/8	66.93
15/16	82.89	15/16	65.10	15/16	68.66
5	85.00	5	66.76	5	70.41
1/8	89.30	1/8	70.14	1/8	73.98
1/4	93.72	1/4	73.60	1/4	77.63
3/8	98.23	3/8	77.15	3/8	81.37
1/2	102.8	1/2	80.77	1/2	85.19
5/8	107.6	5/8	84.49	5/8	89.11
3/4	112.4	3/4	88.29	3/4	93.12
7/8	117.4	7/8	92.17	7/8	97.21
6	122.4	6	96.14	6	101.4
1/8	127.6	1/8	100.2	1/8	105.7
1/4	132.8	1/4	104.3	1/4	110.0
3/8	138.2	3/8	108.5	3/8	114.4
1/2	143.0	1/2	112.8	1/2	119.0
5/8	149.2	5/8	117.2	5/8	123.6
3/4	154.9	3/4	121.7	3/4	128.4
7/8	160.8	7/8	126.2	7/8	133.1

For HIGH SPEED STEEL, add 10 per cent. to listed weights

BAR STEEL

WEIGHT PER LINEAL FOOT—Continued

SQUARE		ROUND		OCTAGON	
Inch	Pounds	Inch	Pounds	Inch	Pounds
7	166.6	7	130.8	7	138.1
1/8	172.6	1/8	135.6	1/8	143.0
1/4	178.7	1/4	140.4	1/4	148.1
3/8	184.9	3/8	145.3	3/8	153.2
1/2	191.3	1/2	150.2	1/2	158.4
5/8	197.7	5/8	155.2	5/8	163.7
3/4	204.2	3/4	160.3	3/4	169.1
7/8	210.8	7/8	165.6	7/8	174.7
8	217.6	8	171.0	8	180.4
1/4	231.4	1/4	181.8	1/4	191.7
1/2	245.6	1/2	193.0	1/2	203.6
3/4	260.3	3/4	204.4	3/4	215.6
9	275.4	9	216,3	9	228.1
1/4	290.9	1/4	228.5	1/4	241.0
1/2	306.8	1/2	241.0	1/2	254.2
3/4	323.2	3/4	253.9	3/4	267.8
10	340.0	10	267.0	10	281.6
1/4	357.2	1/4	280.6	1/4	295.9
1/2	374.9	1/2	294.4	1/2	310.5
3/4	392.9	3/4	308.6	3/4	325.5
11	411.4	11	323.1	11	340.8
1/4	430.3	1/4	337.9	1/4	356.4
1/2	449.6	1/2	353.1	1/2	372.4
3/4	469.4	3/4	368.6	3/4	388.8
12	489.6	12	384.4	12	405.4

For HIGH SPEED STEEL, add 10 per cent. to listed weights

NUMBER OF REVOLUTIONS REQUIRED TO OBTAIN SURFACE SPEEDS OF FROM 20 FEET TO 60 FEET PER MINUTE ON DIAMETERS FROM 1 INCH TO 40 INCHES

Diam., Inches	Circum., Inches	Circum., Feet	Surface Speeds per Minute			
			40 Feet	45 Feet	50 Feet	60 Feet
1	3.1416	0.261	152.789	171.887	190.986	229.182
2	6.2832	0.523	76.394	85.944	95.493	114.590
3	9.4248	0.785	50.929	57.296	63.662	76.394
4	12.5664	1.047	38.197	42.971	47.746	57.296
5	15.7080	1.309	30.557	34.377	38.197	45.836
6	18.850	1.570	25.465	28.648	31.831	38.197
7	21.991	1.832	21.826	24.555	27.283	32.740
8	25.133	2.094	19.098	21.486	23.873	28.647
9	28.274	2.356	16.976	19.098	21.220	25.464
10	31.416	2.618	15.278	17.188	19.098	22.918
11	34.558	2.879	13.889	15.626	17.362	20.834
12	37.699	3.141	12.732	14.324	15.915	19.098
13	40.841	3.403	11.753	13.222	14.691	17.629
14	43.982	3.665	11.167	12.277	13.641	16.370
15	47.124	3.927	10.185	11.459	12.732	15.278
16	50.265	4.188	9.55	10.743	11.936	14.324
17	53.407	4.450	8.99	10.018	11.234	13.481
18	56.549	4.712	8.49	9.55	10.610	12.732
19	59.690	4.974	8.04	9.05	10.028	12.062
20	62.832	5.236	7.64	8.59	9.55	11.459
21	65.973	5.497	7.28	8.19	9.09	10.913
22	69.115	5.759	6.94	7.81	8.68	10.417
23	72.257	6.021	6.64	7.47	8.30	9.987
24	75.398	6.283	6.37	7.16	7.96	9.549
25	78.540	6.545	6.11	6.88	7.64	9.167
26	81.681	6.806	5.88	6.61	7.35	8.81
27	84.823	7.068	5.66	6.37	7.07	8.49
28	87.965	7.330	5.47	6.14	6.82	8.19
29	91.106	7.592	5.27	5.93	6.59	7.90
30	94.248	7.854	5.09	5.73	6.37	7.64
31	97.389	8.115	4.93	5.54	6.16	7.39
32	100.53	8.377	4.77	5.37	5.97	7.16
33	103.67	8.639	4.63	5.21	5.79	6.95
34	106.81	8.901	4.49	5.06	5.62	6.74
35	109.96	9.163	4.37	4.91	5.46	6.55
36	113.10	9.425	4.24	4.77	5.31	6.37
37	116.24	9.686	4.13	4.64	5.16	6.19
38	119.38	9.948	4.02	4.52	5.03	6.03
39	122.52	10.210	3.92	4.41	4.90	5.88
40	125.66	10.472	3.82	4.29	4.77	5.73

NUMBER OF REVOLUTIONS REQUIRED TO OBTAIN SURFACE SPEEDS OF FROM 20 FEET TO 60 FEET PER MINUTE ON DIAMETERS FROM 1 INCH TO 40 INCHES

Diam., Inches	Circum., Inches	Circum., Feet	Surface Speeds per Minute			
			20 Feet	25 Feet	30 Feet	35 Feet
1	3.1416	0.261	76.397	95.493	114.590	133.690
2	6.2832	0.523	38.197	47.746	57.296	66.845
3	9.4248	0.785	25.465	31.831	38.197	44.563
4	12.5664	1.047	19.099	23.873	28.647	33.422
5	15.7080	1.309	15.279	19.098	22.918	26.738
6	18.850	1.570	12.732	15.915	19.098	22.281
7	21.991	1.832	11.167	13.641	16.370	19.098
8	25.133	2.094	9.55	11.936	14.324	16.711
9	28.274	2.356	8.49	10.610	12.732	14.854
10	31.416	2 618	7.64	9.55	11.459	13.369
11	34.558	2.879	6.94	8.68	10.417	12.100
12	37.699	3.141	6.37	7.96	9.55	11.083
13	40.841	3.403	5.88	7.35	8.81	10.283
14	43.982	3.665	5.47	6.82	8.19	9.55
15	47.124	3.927	5.09	6.37	7.64	8.91
16	50.265	4.188	4.77	5.97	7.16	8.36
17	53.407	4.450	4.49	5.62	6.74	7.86
18	56.549	4.712	4.24	5.31	6.36	7.43
19	59.690	4.974	4.02	4.91	6.03	7.04
20	62.832	5.236	3.82	4.77	5.73	6.68
21	65.973	5.497	3.64	4.55	5.46	6.37
22	69.115	5.759	3.47	4.34	5.21	6.08
23	72.257	6.021	3.32	4.15	4.98	5.81
24	75.398	6.283	3.18	3.98	4.77	5.57
25	78.540	6.545	3.06	3.82	4.58	5.35
26	81.681	6.806	2.94	3.67	4.41	5.14
27	84.823	7.068	2.83	3.53	4.34	4.95
28	87.965	7.330	2.73	3.41	4.09	4.77
29	91.106	7.592	2.63	3.29	3.94	4.61
30	94.248	7.854	2.55	3.18	3.82	4.46
31	97.389	8.115	2.46	3.08	3.69	4.31
32	100.53	8.377	2.39	2.98	3.58	4.18
33	103.67	8.639	2.32	2.89	3.47	4.05
34	106.81	8.901	2.25	2.81	3.37	3.93
35	109.96	9.163	2.18	2.73	3.27	3.82
36	113.10	9.425	2.12	2.65	3.18	3.71
37	116.24	9.686	2.06	2.58	3.09	3.61
38	119.38	9.948	2.01	2.51	3.02	3.52
39	122.52	10.210	1.96	2.45	2.94	3.43
40	125.66	10.472	1.91	2.39	2.86	3.34

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